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HOW DO WE SEE WHEN THE LIGHT IS NOT "ENOUGH"? MENTAL REPRESENTATIONS OF PRE-SERVICE PRESCHOOL TEACHERS

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ABSTRACT

In this article we present a research treating with the study of pre-service preschool teachers' mental representations on the mechanism of vision in environments with little to no light. After introducing three separate situations within the framework of an individual, semi-structured interview, we concluded that the main mechanism associated with difficulty or absence of vision is, generally, either dim lighting, or the lack of a light source. Furthermore, certain centrations based on experience were designated, such as vision in limited distance, the autonomy of darkness, or vision through "familiarization" with darkness.

KEY WORDS: Vision, mental representations, physics education, pre-service preschool teachers.

THEORETICAL FRAMEWORK

The research in the fields of Science Education and Educational Psychology during the last 50 years has shown that the approach of the natural world by human thought is achieved through mental representations: these are created both under the influence of the natural as well as the broader social environment, and within the framework of education (Driver, Guesne & Tiberghien, 1985; Johsua & Dupin, 1993; Boilevin, 2013; Kambouri, 2015). One part of the research concerning mental representations of the natural sciences' phenomena and concepts is related to the understanding of optical phenomena (Resta-Schweitzer & Weil-Barais, 2007; Ravanis & Boilevin, 2009; Métioui & Trudel, 2010, 2012; Ravanis, Zacharos & Vellopoulou, 2010; Trinkl, 2012; Delserieys, Jégou & Givry, 2014; Grigorovirch, 2015; Rodriguez & Castro, 2016). Common ground, among these researches, is the matter of vision; namely, the problem relative to the understanding of the mechanism that renders visible objects on which light from various light sources falls, while part of that light is retransmitted to our eyes.

A broad range of researches, which were carried out with subjects spanning from primary education students to teachers, have led to a classification of findings according to which vision is comprehended as the result of interaction between light, objects, and the eye (Andersson & Karrqvist, 1983; Guesne, 1984; Fawaz & Viennot, 1986; Ramadas & Driver, 1989; Selley, 1996; Ravanis, 2000; Dedes, 2005; Kokologiannaki & Ravanis, 2012, 2013). According to a typical classification, nine different mechanisms have been formulated on the matter of vision (Selley, 1996):

1. Cooperative Emission: Both the eye and the light source emit light towards the object.

2. Stimulated Emission: The light reaches the eye and is then retransmitted or causes the emission of a light beam towards the object.

3. Simple Emission: The eye sends light to the object.

4. Stimulated Emission with Reflection: The light leaves the light source, reaches the eye, is then retransmitted or provokes a secondary emission towards the object. The object then retransmits the light, which returns to the eye.

5. Primary Reception: The light source lights the eye – this model involves primary light sources.

6. Secondary Reception: The light travels from the light source first to the object, then to the eye – this model involves objects retransmitting light from a primary light source.

7. Secondary Recepto-Emission: The light travels from the light source to the object, it then "bounces" towards the eye, the eye then emits something towards the object.

8. Sea of Light: The light source generally lights the space and this is the reason we can see.

9. Dual Illumination: The light source lights both the eye and the object at the same time.

However, even though the issue of the relationship between light – object – eye is sufficiently explored, the issue of vision in environments with little to no lighting is rarely posed. In a relative research with 11-year-old students, it appeared that the "Sea of Light" model was the one that many children chose to use in order to explain vision during nighttime. But the majority of students do not answer adequately enough to embody their idea to a certain mechanism.

In the research presented here we attempted to trace the way in which pre-service preschool teachers perceive the phenomenon of vision during nighttime, or with dim natural light.

METHODOLOGICAL FRAMEWORK

The procedure and the sample

The research sample was comprised of 30 pre-service preschool teachers, of about 20 years old, who were not yet introduced to the study of optical phenomena in academic courses. The individual, semi-structured interviews that were carried out took place in a specifically prepared space, and lasted 8-10 minutes each. The interviews were recorded, and their analysis was realized based on the transcript of the recording.

The interview

The interview was carried out with three main questions-situations, based on which the dialogue was expanded.

1. Waking up at nighttime, can you see the objects in your room? Why? What is helping you? (If the answer is affirmative). Why? What is stopping you? (If the answer is negative).

2. If I showed you this black pencil during nighttime, would you be able to see it? Why? What helps you see it? (If the answer is affirmative). Why? What stops you from seeing it? (If the answer is negative).

3. We present three images portraying dimly lit environments (Figure) and ask: do you believe that everyone is able to see everything around them? Why? What helps them see? (If the answer is affirmative). Why? What stops them from seeing? (If the answer is negative).

Figure. Images portraying dimly lit environments

RESULTS

Drawing on the analysis of the conversations we created three levels of answers based on their relationship with the model of Geometrical Optics. Thus, the answers in which it is recognized that vision is the result of retransmission or reflection of light by the objects are characterized as "Compatible". The answers in which it is recognized that the objects are lit but there is confusion concerning the functional role of eyes are characterized as "Intermediate". In conclusion, the answers in which vision is not discussed based on lighting and certain mechanisms but based on centrations on various functional characteristics of situations

are characterized as "Incompatible".

1st question: Can we see the objects in our room at nighttime?
Based on the analysis of the answers to this question, we conclude on the following results:

- Only one answer out of 30 can be characterized as "Compatible", since it sets as a condition of vision the transmission of light to an object and its reflection towards the eye: "I cannot see. Because there is no light that will fall on the objects, which will reflect and come to my eye so I can see".

- In the category of "Intermediate" answers, we have 19 answers in which the absence of light is recognized as the cause of the inability to see, but the justifications are either absent, or fail to propose an adequate mechanism. For example, "There is no brightness", "I do not have light…".

- In the 10 "Incompatible" answers, there is no reference to light, and the explanation of the phenomenon of vision, or its impossibility is attributed to something else. Five answers refer to "darkness": for example, "Darkness stops me", "Everything is black", "I see black". Darkness here is not related to the lack of light, but refers to an entity with an almost autonomous function. In three of the answers, eyes play an important role: for example, "I will not see, because my eyes are not used to the darkness", "I will see faintly, when the time passes and my eyes get used to the darkness". The two final answers attribute a special role in the ability to see because of experience: "I will see just a little bit, because either way I know that the vase is to my right, the chair is to my left and I will not trip…", "I see their shadow, their outline. Habit helps me, because I know where each object is".

2nd question: Will we be able to see a black pencil during nighttime?
In this case, after we asked for an evaluation on a certain object, we collected answers, which we classified into three levels:

- Only 1 answer is characterized as classified, which mentions the inability to see the pencil because of the absence of light: "Of course I will not see it. Because there is no light that will fall on it, and reflect so I can see it".

- We characterize 19 answers as "Intermediate", in which the absence of light is dominant, but the suggested explanatory mechanisms are not satisfactory. For example, "There is no light for me to be able to see it", "… The light would light it, and I would be able to see it better", "There is no light, neither from the moon, not from the lamp….".

- The answers in which there is no reference to light are characterized as "Incompatible". Two of the answers attribute darkness to a particular entity: "No. Because darkness obstructs me", "As long as I have my eyes open, all I will see is black". Four answers attribute a special role to the eyes. For example, "My eyes. As the time passes, they can perceive it and see its shape, so I can understand it is a pencil", "My eyes will get used to the dark and I will see it", "If I have my eyes open and concentrate, I will be able to see it after a while". In two answers, we discover for the first time the matter of the objects' color. For example, "Because it is black, in the dark I am not able to see it. If it was white I would be able to see it…" Finally, in two answers, the matter of distance is posed: "It depends on the distance, if it is close to my eyes or afar", "If it is close to me, I will see it".

3rd question: Can everybody depicted in the images see everything?
The analysis of the conversations carried out on the subject of images yielded the following results:

- One answer is characterized as "Compatible", which refers to the role of the light as a basic factor of the human capacity to view images. In the explanation, the existence of light, even if it is dim and coming from the moon, the stars, or a candle, is set as a precondition, while there is also reference to the concept of reflection. The only example of this category is the answer: "Because there is in all three cases a light source, that shines light on the objects, which are near the people. This light will be reflected and reach their eyes. Thus, the faces of the images can see at a close distance".

- In the level named "Intermediate", we classify 24 answers in which there is reference to role of the existence of light for the people's capacity to see, but the justification is either lacking, false, or absent. For example: "They see what is light by the light of the moon, of the candle…", "There is some light from the moon, if it was a full moon they would see better / the candle allows for them to see as far as it is able to light", "They cannot see everything, because there is no light", "…There is no strong light… the little girl can see only at a close distance, the little boy can only see the moon… the couple can only read the menu if they bring the candle close enough".

- We characterize 5 answers as "Incompatible", in which there is no reference to the light, but possible vision of the images by people is attributed to various other factors. In two of the answers, the darkness is again recognized as an autonomous entity: "I think not. Because darkness is dominant, therefore they will not be able to see anything", "No. Because as a whole, the pictures are dark". In one answer, a special role of the eyes is key: "They will see only a little, but only as far as their eye can reach". Finally, in two answers, vision is associated with the issue of distance: "They can't see everything. Their vision is limited because they can see at a close distance", "Yes, but they will only be able to see whatever is at a close distance".

CONCLUSION AND DISCUSSION

In this paper, there was an effort to approach the subject of understanding the mechanism of vision, in environments with little to no light. This matter is rarely a subject of research, even though it seems to allow for the tracing of specific mental representations, which are not approached in the study of situations with strong light sources.

As it appears from the results, there is significant difficulty in identifying a mechanism of vision in the absence of strong light. The majority of answers which we characterize as "intermediate", in all three situations in which they are proposed, based on the Selley (1996) classification, approach the category of "Sea of Light" from an opposite side since they simply invoke the absence of light to explain the inability to see. Furthermore, the same phenomenon was observed in a research with 11-year-old children (Kokologiannaki & Ravanis, 2012). Thus, it appears that the absence of perceptible light obstructs the formulation of various other mechanisms of vision in their thought.

At the same time, the simple concept of the absence of light leads to mental representations based on certain factors based on experience, such as the relationship between the intensity of the light source and the distance up to which we can see; the concept of vision through simple "familiarization" with darkness; the designation of color as a factor related with the ability to see, and the attribution of relative autonomy to darkness, without referring to the absence of light (Ravanis, 1998; Dumas Carré, Weil-Barais, Ravanis & Shourcheh, 2003).

From the point of view of education, these results indicate that the matter of light intensity also influences every discussion concerning the understanding of vision. Indeed, the categories of answers received on vision with or without dim lighting denote, on the one hand powerful limitations in the attributed vision mechanisms, and on the other hand mental representations that are based on centrations on perceptive factors, similar to the ones located in other issues concerning the understanding of Optics.

These matters require further study, both in relation to the expansion of a spectrum of suggested situations, and to the age development of students, since their designation could help in the teacher training in the field of physics education (Karalis, Sotiropoulos & Kampeza, 2007; Kakana, 2012; Maurício, 2015).

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